

WE CLAIM:

1. A system for making a coated plastic container possessing a gas barrier, the system comprising:
 - a vacuum cell capable of maintaining a vacuum within the vacuum cell;
 - at least one coating source disposed in the vacuum cell for supplying a coating vapor to an external surface of a plastic container, having an interior volume and positioned within the vacuum cell, wherein the at least one coating source comprises:
 - an evaporator for heating and evaporating an inorganic coating material to form the coating vapor; and
 - a means for energizing the coating vapor to form a plasma; and
 - one or more gas feeds for supplying one or more process gases into an interior space of the vacuum cell, wherein at least one of the process gases is a carbon-containing gas;
 - wherein the at least one coating source is arranged within the vacuum cell such that the plasma reacts with at least one of the process gases and a thin coating is deposited and bonded on the external surface of the plastic container, the thin coating comprising carbon from the carbon-containing gas and inorganic material from the inorganic coating material.
2. The system of claim 1, wherein the carbon-containing gas is a low-molecular weight organic gas or a gas mixture which comprising a low-molecular weight organic gas.
3. The system of claim 2, wherein the carbon-containing gas is selected from the group consisting of acetylene, ethylene, ethane, and mixtures thereof.
4. The system of claim 3, wherein the carbon-containing gas comprises acetylene.
5. The system of claim 1, wherein at least one of said one or more process gases is selected from the group consisting of oxygen, nitrogen, sulfur, and halogens.

6. The system of claim 1, wherein the inorganic coating material is selected from the group consisting of silicon, metals, and combinations thereof.
7. The system of claim 1, wherein said one or more process gases comprises oxygen and the inorganic material in the thin coating comprises an inorganic oxide.
8. The system of claim 7, wherein the inorganic coating material comprises a metal and the inorganic oxide is a metal oxide.
9. The system of claim 8, wherein the metal oxide is aluminum oxide.
10. The system of claim 8, wherein the metal oxide is an oxide of a quadra-valent metal.
11. The system of claim 10, wherein the quadra-valent metal is titanium.
12. The system of claim 7, wherein the inorganic oxide comprises an oxide of silicon.
13. The system of claim 7, wherein the thin coating is a colorless, transparent oxide coating.
14. The system of claim 1, wherein at least one of the process gases is a reactive gas which, in combination with the inorganic coating material, results in the thin coating being colored.
15. The system of claim 1, wherein at least one of said one or more process gases is selected from the group consisting of argon, xenon, neon, krypton, and helium.
16. The system of claim 1, further comprising a container feeder for supplying a plurality of plastic containers into and withdrawing coated plastic containers out from the vacuum cell.
17. The system of claim 1, further comprising a conveyor within the vacuum cell for conveying one or more of the containers through the vacuum cell.

18. The system of claim 1, wherein the at least one coating source comprises
a crucible electrically connected as an anode for containing at
least a portion of the inorganic coating material; and
a cathode directed at the portion of the coating material in the
crucible for at least partially vaporizing the coating material and forming the
coating vapor into plasma.
19. The system of claim 1, wherein the cathode is vaporizable to form a
portion of the coating vapor.
20. The system of claim 1, further comprising a subsystem for applying a
polymer coating onto the thin coating which comprises carbon and the inorganic
coating material, for applying a polymer coating between the external surface of
the container and the thin coating which comprises carbon and the inorganic
coating material, or for both.
21. The system of claim 1, wherein the resulting coated plastic container,
when containing four volumes of carbon dioxide sealed in the interior volume,
has a gas barrier of at least 1.25x the gas barrier of the plastic container without
the coating, when the plastic container without the coating contains four
volumes of carbon dioxide sealed in the interior volume.

22. A system for making a coated plastic container possessing a gas barrier, the system comprising:

- a first vacuum cell capable of maintaining a vacuum within the vacuum cell;

- at least one main coating source disposed in the first vacuum cell for supplying a coating vapor to an external surface of a plastic container, having an interior volume and positioned within the first vacuum cell, wherein the at least one main coating source comprises:

 - an evaporator for heating and evaporating an inorganic coating material to form the main coating vapor; and

 - a means for energizing the main coating vapor to form a main plasma;

- one or more gas feeds for supplying one or more process gases into an interior space of the first vacuum cell; and

- at least one polymer coating source disposed in a second vacuum cell capable of maintaining a vacuum, for adding one or more coatings of polymer onto the plastic container, positioned within the second vacuum cell, wherein the at least one polymer coating source comprises:

 - a second gas feed comprising a polymerizable gas; and

 - a means for energizing the polymerizable gas to form a plasma comprising polymerizable free radicals;

- wherein the at least one main coating source is arranged within the first vacuum cell such that the main plasma reacts with at least one of the process gases and a thin main coating bonded is deposited and bonded, directly or indirectly, onto the plastic container, the thin main coating comprising the inorganic coating material; and

- wherein the at least one polymer coating source is arranged within the second vacuum cell such that the polymerizable free radicals deposit and polymerize to form a thin polymer coating, directly or indirectly, onto the plastic container, the thin polymer coating being distinct from the thin main coating.

23. The system of claim 22, wherein the first vacuum cell and the second vacuum cell are different regions of the same vacuum cell.

24. The system of claim 22, wherein the thin polymer coating is an undercoat deposited and bonded onto the external surface of the plastic container prior to application of the main coating which then is deposited and bonded onto the exterior surface of the thin polymer coating.
25. The system of claim 22, wherein the thin polymer coating is a topcoat deposited and bonded onto the exterior surface of the thin main coating.
26. The system of claim 24, wherein a second thin polymer coating is deposited and bonded onto the exterior surface of the thin main coating, such that the thin main coating is sandwiched between the thin polymer coating and the second thin polymer coating.
27. The system of claim 22, wherein the polymerizable gas comprises an olefin, a paraffin, or a mixture thereof.
28. The system of claim 22, wherein the polymerizable gas comprises ethylene, acetylene, or a mixture thereof.
29. The system of claim 22, wherein the second gas feed further comprises an inert gas selected from the group consisting of argon, xenon, neon, krypton, helium, and mixtures thereof, in an amount effective to enhance the plasma of the polymerizable gas.
30. The system of claim 22, wherein at least one of the process gases is a carbon-containing gas, such that the thin main coating comprising carbon from the carbon-containing gas.
31. The system of claim 22, wherein the polymerizable gas is energized by gas discharge in a direct current electric field.
32. The system of claim 22, wherein the coated plastic container, when containing four volumes of carbon dioxide sealed in the interior volume, possesses a gas barrier of at least 1.25x the gas barrier of the plastic container without the coating, when the plastic container without the coating contains four volumes of carbon dioxide sealed in the interior volume.

33. A system for making a coated plastic container possessing a gas barrier, the system comprising:

- a first vacuum cell capable of maintaining a vacuum within the vacuum cell;

- at least one main coating source disposed in the first vacuum cell for supplying a coating vapor to an external surface of a plastic container, having an interior volume and positioned within the first vacuum cell, wherein the at least one main coating source comprises:

 - an evaporator for heating and evaporating an inorganic coating material to form the main coating vapor; and

 - a means for energizing the main coating vapor to form a main plasma;

- one or more gas feeds for supplying one or more process gases into an interior space of the first vacuum cell; and

- at least one polymer coating source disposed in a second vacuum cell capable of maintaining a vacuum, for adding one or more coatings of polymer onto the plastic container positioned within the second vacuum cell, wherein the at least one polymer coating source comprises a melter-evaporator for heating and evaporating a vaporizable polymer to form a polymer coating vapor, the vaporizable polymer being evaporable under vacuum conditions without decomposing;

- wherein the at least one main coating source is arranged within the first vacuum cell such that the main plasma reacts with at least one of the process gases and a thin main coating is deposited and bonded, directly or indirectly, onto the plastic container, the thin main coating comprising the inorganic coating material; and

- wherein the at least one polymer coating source is arranged within the second vacuum cell such that the polymer coating vapor recondenses and deposits to form a thin polymer coating, directly or indirectly, onto the plastic container, the thin polymer coating being distinct from the thin main coating.

34. The system of claim 33 wherein the first vacuum cell and the second vacuum cell are different regions of the same vacuum cell.

35. The system of claim 33, wherein the thin polymer coating is an undercoat deposited and bonded onto the external surface of the plastic container prior to application of the main coating which then is deposited and bonded onto the exterior surface of the thin polymer coating.
36. The system of claim 33, wherein the thin polymer coating is a topcoat deposited and bonded onto the exterior surface of the thin main coating.
37. The system of claim 35, wherein a second thin polymer coating is deposited and bonded onto the exterior surface of the thin main coating, such that the thin main coating is sandwiched between the thin polymer coating and the second thin polymer coating.
38. The system of claim 33, wherein the vaporizable polymer comprises a polyolefin, a polyester, a polycarbonate, or a mixture thereof.
39. The system of claim 33, wherein the vaporizable polymer comprises polyethylene.
40. The system of claim 33, wherein at least one of the process gases is a carbon-containing gas, such that the thin main coating comprising carbon from the carbon-containing gas.
41. The system of claim 33, wherein the coated plastic container, when containing four volumes of carbon dioxide sealed in the interior volume, possesses a gas barrier of at least 1.25x the gas barrier of the plastic container without the coating, when the plastic container without the coating contains four volumes of carbon dioxide sealed in the interior volume.
42. A system for packaging a beverage comprising:
a system for making a coated plastic container as in claim 1;
a filler for filling the plastic containers with a beverage; and
a sealer for sealing the plastic containers after the step of filling.

43. A system for packaging a beverage comprising:
- a system for making a coated plastic container as in claim 22;
 - a filler for filling the plastic containers with a beverage; and
 - a sealer for sealing the plastic containers after the step of filling.
44. A system for packaging a beverage comprising:
- a system for making a coated plastic container as in claim 33;
 - a filler for filling the plastic containers with a beverage; and
 - a sealer for sealing the plastic containers after the step of filling.